IoT Resources for Outdoor Play

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ABSTRACT

This position paper argues that IoT tool-kit resources can enable children to be experts of their own experience and create new kinds of outdoor play. We advocate for physical-digital designs and present various ways that children may be enabled to create digital interactions in play. In turn, we suggest that in-the-moment adaptions and direct-control can support social negotiation and emerging opportunities in open-ended play. Finally, we suggest that future studies should investigate the role of shared ownership and community resources in enabling sustained engagement with such tool-kit resources.

KEYWORDS

Outdoors; IoT; Tool-kits; Children; Co-Design

CHI'19 Extended Abstracts, May 4-9, 2019, Glasgow, Scotland, UK.

ACM ISBN 978-1-4503-5971-9/19/05.
DOI: https://doi.org/10.1145/3290607.XXXXXXX

Figure 1. This drawing shows amongst other things the use of street furniture in games the children played, for example, the green telephone exchange box in the middle of the figure.

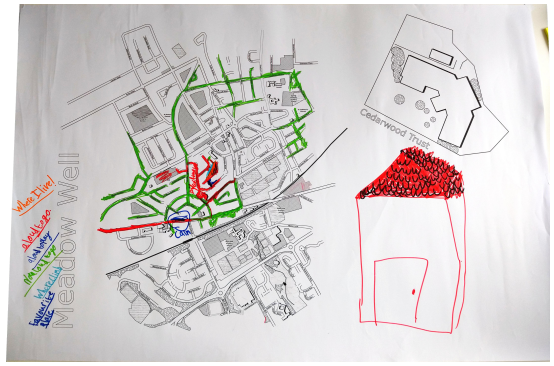

Figure 2. This map shows places a participant played, along with a key describing favourite places, places they are allowed to go and a calm place to "hang out" with friends.

Introduction

Nowadays there are numerous kits that allow children to make interactive artefacts by programming sensors and outputs and creatively combining those with craft materials. Our research builds on the popularity of these kits by investigating how they may enable children to create new forms of outdoor play. In the UK where our research takes place, and in many other post-industrial societies, children are playing out less than they ever have. Evidence suggests various reasons for this trend include neighbourhood safety [3], concerns for increased traffic on roads [5], increasing awareness of "stranger danger" [1,2] and an increased consumption of screen-based media [6, 7]. Spending less time outdoors has a potential impact on the health, well-being and social development of children [4] and though technology may be partly responsible, we believe it could also be the solution, by offering novel experiences that encourage and support new forms of outdoor play.

An overarching question driving our work is: What is the value and design potential of IoT toolkit resources for children's outdoor play? We argue in this paper that IoT tool-kit resources can enable children to be experts of their own experience by creating new kinds of outdoor play. Play takes on new meaning outdoors as children respond to fresh air, freedom, and opportunities in the environment around them. Alongside these opportunities, there are practical challenges and questions for us as designers. On a practical level, we also ask: how do we create tool-kit resources robustly, in a way that warrants and encourages outdoor play? What behaviours should we encourage and therefore what design qualities should we be working towards? And how may such tool-kits be co-created with children?

To date, our work has principally focused on a design ethnography involving a community centre that provides activities for children outside of school time. At the community centre, we have run workshops and co-created play with children and experienced play facilitators (with and without technology) to inform our understanding of how to design these tool-kit resources. Initial workshops involved, drawing what play means (Figure 1), mapping play in the local area (Figure 2), and locating play by visiting places were the children played (Figure 3). During this workshop children introduced us to a number of different games and so in proceeding research we asked them to show us how they played those games. The experience of playing together, and observing the children playing freely, has been invaluable to us in understanding play, both tacitly and explicitly, and has led to a variety of exploratory prototypes that have subsequently been played with by the children. While the children often play by themselves, we have learnt from and observed experienced play facilitators, who have been key in directing us to open play that has a degree of scaffolding and therefore encourages positive and sustained play amongst groups of children.

Alongside investigating the design of these resources, the embedded nature of our research has meant we have been responding to the realities of play in situ. This proves important, as we discuss here, yet is often overlooked in the literature, which tends to focus on specific affordances of a design or technology, rather than broader concerns around social scaffolding and how we implement IoT resources for

Figure 3. The children were asked to locate play in the local neighbourhood by drawing on and hanging cards showing what they play.

Figure 4. The Play Poles at the community centre.

outdoor play. In the following sections we unpack key positions/themes in our work that have emerged through our design research activities and analysis to date.

Physical-Digital

Our work emphasises physical-digital interactions that are embodied and without screens. While we appreciate the role that mobile devices might play, we are interested in physical interactions and embedded IoT devices that sit alongside other physical artefacts including other play resources (i.e. bats and balls), craft materials and nature itself. We want to encourage shared, embodied interaction and to be wary of drawing children's attention away from the outdoors and other children. We have found physical-digital interactions to be engaging for children who often see technology as something principally screen based. Through physical-digital artefacts, we emphasise the embodiment of outdoor space and the natural, physical world.

Creating and Interacting

Working towards tool-kit resources has meant investigating what form tool-kit resources might take. How can we enable children to adapt them and what role can they play alongside other resources? Initial work has involved using the micro:bit (info / foot note or margin), as a readily available, affordable and robust device that is already designed with children in mind. As a starting point, the micro:bit has allowed us to explore with the children how we create play with digital interactions. After learning about play in our initial workshops we created a set of preliminary micro:bit designs that were introduced to children with an interest in programming. After playing with our designs, the children were encouraged to adapt the code to create and play their own outdoor games together. Having looked at coding and children who enjoy coding, we decided to further investigate other ways of introducing digital interaction in play. In response, we created a set of functions on individual micro:bit that could be used as buildings blocks, to be combined and adapted by the children within play, and studied their creative engagement.

Both approaches had some successes, however, we found the children wanted to make quick changes, in the moment, and decided to create a prototype that explored the direct control of digital interactions. At the same time, we chose to explore other forms the micro:bit might take, when added to other physical design components. In this case we moved away from even the small, lo-resolution screen of the micro:bit to an entirely physical design that we envisage the children building and adapting with craft materials. The Play Poles (see Figure 5 for a description of functionality) were designed to have a clear and simple function that meant the children could swiftly devise creative things to do with the Poles, such as inventing and adapting outdoor games to play together. To give the children direct in the moment control of digital interactions, we decided to give them a controller. The controller provides a means of acting out interactions simply by pressing buttons, but also became central to many games the children played with the Play Poles.

We observed active-free-play, which involved the children taking turns controlling the Poles, and with other children running around together frantically, trying to "catch all the targets" (one of the children participating). Facilitators also supported the children in creating games with structure, were the controller became an important and popular role in games that bore similarities to games we had observed them playing previously.

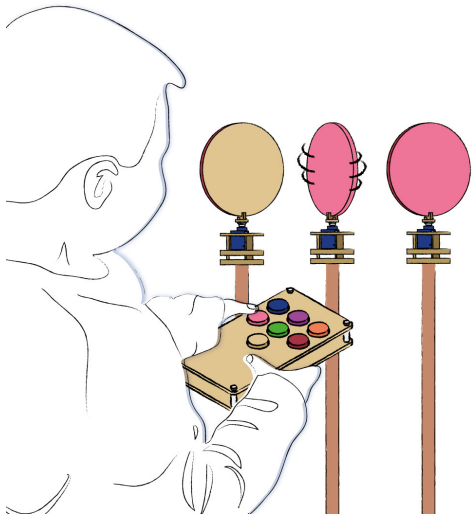

Figure 5. The poles flip when you press a matching colour on the controller.

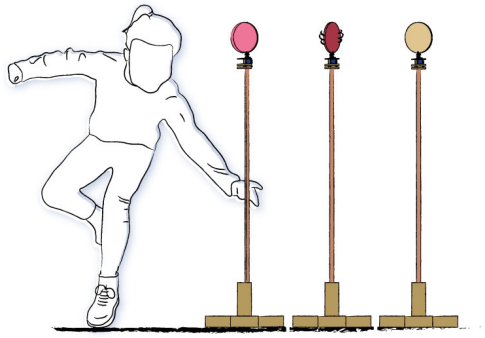

Figure 6. The poles flip back when you touch the copper pipe.

Shared ownership and responsibility

Alongside considering play itself, the Play Poles highlighted broader concerns about how we implement and support children in the use of such tool-kit resources. Important questions include: What is required to enable groups of children to take shared responsibility for tool-kit resources? How do we enable children to play together in the local area, on their own terms? In early trials of the Play Poles we found children taking group ownership and responsibility for them. By co-analysing video data with play facilitators, the importance of group ownership became evident. The children had created one game in particular and had begun taking responsibility for organising their friends, and arranging the Poles, to play the game. In response to observing this footage, one facilitator explained: "*It's like, this is our game now, that's important. They've created that game. So, we're going to play because we know how to do it, nice to see*". Relatedly, in leaving core components and the functionality of the Play Poles visible, we found the children were keen to engage, explore and understand. This led to expressions of ownership and appeared to invoke a sense of shared care and responsibility, with children testing and reporting problems with the Play Poles, both together and on their own terms. Here we have highlighted the importance of ownership and shared responsibility, which raises future questions about what broader support is required to enable children to use IoT tool-kits together, in the community? What role can community centers play and what additional resources are required to create a sustained initiative that supports outdoor play?

Scaffolding

While we want to enable children to create their own play through open-ended resources, we have found a degree of scaffolding allows group play to be fair, sustained and enjoyable for everyone involved. Experienced play facilitators have always been keenly aware of how our prototypes are enabling positive experiences for the children. For example, while discussing a game the children played with the Play Poles, one such facilitator explained, "*We are good at doing games or activities where you limit that possibility. It is taking them aware from feeling like they might be excluded, or are not good enough, or to make them feel good about themselves.*"

The play created by children varied, sometimes everyone got on and no one fell out, while sometimes particular children created situations that caused a break down in social cohesion. We have found our design to be valued as an 'open resource' that affords creative interpretation. However, we have also come to understand the importance of facilitation in the open play context for providing boundaries and limitations to this use. Such facilitation could mean incentivising going outside, managing turn-taking with the remote control, or scaffolding a sense of shared ownership or responsibility for the Play Poles. Another ongoing question in our research is therefore, can design scaffold play, whilst still allowing it be to be open and inventive, and for children to understand how to adapt play in a way that meets the needs and interests of a group and individual players.

Conclusion

In this position paper, we argue for tool-kit resources that support digital interactions and adaptions in play and advocate for the role of direct-control and simplicity. We have also pointed towards the important role of scaffolding, alongside open-ended play and an understanding of broader issues, including support when looking to enable ownership and engagement with tool-kit resources outdoors in the local community.

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